THIRSTY PLANTS

Objectives:

Using this adaptation of a Project WET activity students will:

- explain how plants transport water through transpiration,
- describe the role of transpiration in the water cycle,
- explain how plants can affect the quantity of groundwater.

Materials:

- Copy of the Water Cycle Diagram (found in Water Cycle Game)
- Celery stalks or white carnations
- Paper towel tube
- Paper that is cut into a series of connecting circles
- Clear plastic bag and twist tie for each
- An area that has different types of plants
- Small food scale
- Clear container with water colored with red or blue food coloring



Background:

Most people are familiar with plants and gardens and understand the need for watering plants to ensure successful growth. Students may have observed that plants wilt or die because of lack of water. How plants take in and transport water throughout their structure may be less understood. Learning how water moves through plants helps students appreciate the role of vegetation in the water cycle.

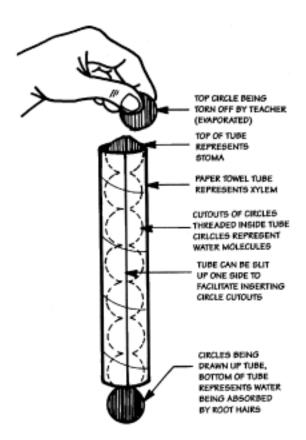
Procedure:

Demonstration:

(Optional) You will have to do step one before doing the rest of the activity so it is ready for the students to see.

- 1. Cut several pieces of celery or white carnations and place them in a container of water with food coloring in it. Allow the food coloring to soak into the plants before showing the students.
- 2. Have students review their copies of the water cycle diagram. Ask students to share what they know of the water cycle and then review how water moves through the environment. Note whether or not they include plants.
- 3. Show the students the celery or carnations that have been soaking in the dyed water. Ask them to make a list of possible explanations for how the water traveled through the cuttings.
- 4. Ask the students to consider a 20-foot tall tree; how do its leaves get water?
- 5. Show the students the paper towel tube with the cutout circles inserted. See diagram. Explain that the tube represents part of the tissue inside a plant (xylem), similar to veins inside our bodies. The paper circles represent water molecules. Water molecules remain inside the tube because they are attracted to each other and to the sides of the tube.

- 6. Point out the water molecule near the top of the tube. Explain that this represents a molecule at a stoma or pore in a leaf. During the day, increased heat energy will cause water to evaporate. Evaporation occurs when the energy of movement (caused by heat energy) is stronger than the forces holding the molecule to other water molecules.
- 7. To show evaporation pull on the top circle to draw the next circle near the top, then tear off the top circle. Explain that this represents a water molecule being evaporated from the leaf (transpiration). When the top molecule leaves the plant, it must break away from surrounding water molecules. This creates a pull on those water molecules, drawing them further up the xylem.



Activity - Build a Tree:

To demonstrate the parts of a tree and how they process water you can build a tree.

- 1. Ask the students to list the parts of a tree.
- 2. As they are listing the parts, assign several students to be various parts.
- 3. Depending on the size of your class, assign one student to be the heartwood of the tree. This is the inner core, the strength of the tree. Ask this student to stand tall and strong and to say, "Thump, thump," like a beating heart.
- 4. The next three students will be the taproots. They will sit at the base of the heartwood and will draw water into the tree. They also anchor the tree to the ground. Point out that not all trees have taproots, but this one does. Ask these students to make sucking sounds.
- 5. The next several students will be the lateral roots. They will lie on their backs with their feet up against the trunk and their bodies extending away from the tree. Tell them there are hundreds and hundreds of them, thousands of miles of roots to slurp up water. Ask them to make slurping sounds. (Students with long hair make excellent examples of the many long lateral roots a tree can have.)
- 6. The next students will be the sapwood. They will form a complete circle around the heartwood, facing inward and holding hands. They are the xylem and draw water from the roots up into the tree at speeds of up to 100 mph. They will make "Wheee" sounds.
- 7. The next students are the cambium or phloem layer. They will form a circle facing the sapwood. They are the growing part of the tree. They are the part of the tree that carries the food manufactured by the leaves to the rest of the tree. Ask them to stand

- with their arms up and their wrists and fingers interlaced. They will make "Whooo" sounds.
- 8. Ask the remaining people to be the tree bark. How do they protect the tree? They can act like a football blocker and they should bark. These are all of the parts of a tree and will represent how water moves through various parts of the tree and eventually gets transpired back to the surface.
- 9. At your command ask the students to act out their parts and watch the tree in action.

Activity – How much moisture is transpired by a plant?:

- 1. Divide the class into small groups; giving each group an empty plastic bag and have them record its weight.
- 2. Identify trees, shrubs, grasses, or small plants located on the school grounds. Houseplants within the class could also work. Assign each group a plant of a different type i.e.: one grass, one tree, one shrub, etc. (More than one group to a plant type also works.)
- 3. Have each group carefully place its bag over part of the plant (a limb of a tree or shrub) facing the sun. Tie the bag with a twist tie or string. Each group should count and record the number of leaves or blades in its bag.
- 4. Challenge the students to develop a method to estimate the number of leaves on the tree or plants in a square foot. After the groups have recorded their estimates; ask each group to carefully examine its bag for changes.
- 5. After 30 minutes (it can be longer, but all bags should be removed at the same time), carefully remove the bag from the plant; take it to the class and weigh it. If leaves or debris are in the bag, remove them before weighing the bag, trying not to remove any of the moisture.
- 6. Have each group measure the amount of moisture accumulated in its bag by using the following formula: weight gain = total weight starting weight.
- 7. Pool the class data and have each group answer the following questions based on the data collected by the class:
 - Which plant transpired the most water?
 - Which plant transpired the least water?
 - Estimate the mass of water each plant would transpire during seven hours of sunlight. Assume a constant rate of transpiration.
 - How would plant cover affect the amount of water that can filter through the soil to become part of groundwater.

Plant name or description	Transpiration Rate (ounces or grams per 30 minutes)	Transpiration seven hour day	Rate	per
Plant 1				
Plant 2				
Plant 3				

Discussion:

- Have students summarize the process of transpiration.
- How did the water get into the plastic bags?
- Discuss the amount of water transpired by plants in the schooly and and where water goes after it leaves the plant.
- Students should have found that some plants transpired more water than others did.
- Discuss the effect different plants would have on the watershed, water entering groundwater, and water entering a cave system.